Survival Trade-Offs: Comparing mass and individual survival of *Lotus wrangelianus* in different treatments.

Bio-461

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Introduction

*Lotus wrangelianus* is a species of flowering plant in the pea family. It is an annual plant which means that its life cycle is complete in one year. It is native to California and can be found in the grasslands of the Coastal Range. *Medicago polymorpha* is a type of legume that reproduces through self-pollination. It originated from the Mediterranean Sea region and was introduced to the United States approximately in the 1800s (Haan and Barnes 1998). Both *Medicago* and *Lotus* plants coexist in the same area and share a similar reproductive period. However, the population of *Medicago* within the *Lotus* community is increasing, leading to direct competition with *Lotus*. Which results in a decrease in the *Lotus* population. In addition to the presence of plants in grasslands, there are herbivores that feed on them. One example is the Egyptian alfalfa weevil (*Hypera* *brunneipennis*). The *Hypera* *brunneipennis* is an exotic herbivore that consumes both *Lotus* and *Medicago*, it arrived in California in approximately 1920’s where it then spread through the south coastal plains (Van Den Bosch and Marble 1971).

There have been studies that have been conducted to simulate the natural environment of the *Lotus* population, considering the presence of *Medicago*, herbivores and the use of insecticides. Studies have shown that the *Lotus* plant is able to survive under such conditions, although its survival through its lifespan can be affected by various factors including its survival based on seed weight. Other factors from its lifespan include leaves on the plant, flowers and pods. Leaves for photosynthesis and growth, flowers for being pollinated and pods for reproduction. *Hypera* can have an effect on *Lotus* leaves, and the presence of *Hypera* on both *Lotus* and *Hypera* plants can impact the quality of reproduction. The use of insecticides can also influence the production of leaves and flowers, but most importantly lower the number of *Hypera*.

Researchers were looking at different types of treatments *Lotus*, *Medicago* and *Hypera* might receive in the natural environment in the Coastal Range of California. Seeing if the non-invasive *Lotus* can survive while being invaded by *Medicago, Hypera* and insecticides. The hypothesis that I am testing in this article is that the weight of *Lotus wrangelianus* transgenerational seeds can increase or decrease survival. Having a heavier seed weight will increase the chance of survival, compared to a lower seed weight which will have a lower survival rate.

Materials and Methods

The *Lotus* data used here came from a paper which used *Lotus* in a natural environment simulation, from November 2003 through May 2004. Then the seeds that were produced in the “parental generation” were used in a corresponding transplant experiment in 2004-2005. There was a total of 458 *Lotus* seeds that were from the transplant experiment. The weight measurement was taken from seeds belonging to the second generation, which were collected from the parental generation between 2003-2004. The weights were recorded were before planting occurred.

The researchers mixed the offspring from the parental plot into different plots (from 1-24) for the following experiment in which they had different treatments. The plots were in a 2 x 2 factorial design and treatments were applied to 24 plots that were 3 m x 3. Survival was recorded on a scale from 0=dead to 1=survived. One treatment was a weeding treatment, with 0=no weeding (Medicago present) and 1= weeding (Medicago reduced). Another treatment was with Sevin (Bayer CropScience, RTP, North Carolina, USA) insecticide with 0= no insecticide (insects present) and 1= insecticide (insects reduced). The insecticide treatments were applied for 2–4-week intervals depending on the amount of rainfall (terHorst and Lau 2012). All data analysis was carried out using R version 4.2.2, the ‘t.test’ function was used to create the graph (Figure 1). Using the function

Results

Chart, box and whisker chart

Description automatically generated

Figure 1.) The t-test illustrates the total number of dead and surviving Lotus seedlings, not taking into consideration the treatments.

Chart, scatter chart

Description automatically generated

Figure 2.) Weight of seedlings compared to the number of leaves that were produced with treatment of Alfalfa Weevil

The t-test that was generated for *Lotus* showed that in the corresponding transplant seeds there was a p-value of 0.1479 with a 95% confidence interval. The mean for 0 (dead) is 3.372618 while the mean for 1 (survived) is 3.482579. There were approximately 3 outliers that fit in the t-test, with all of them surviving having mass of <1 and the other two >5. In Figure 2, there were 146 plants which were from the offspring generation that grew leaves while being treated with insecticide and reduced *Hypera*. There were multiple plants which did not grow a single leaf, although one of the plants stood out having a seedling weight 2.7019g and having 83 leaves.

Discussion

The p-value of 0.1479 indicated that there was not a statistically significant difference in weight between dead and surviving seedlings. The mean survival weight for the dead species was only 0.108861 compared to the *Lotus* that survived. There was no correlation between the survival of Lotus seedlings and their weight, indicating that the weight of the seedling cannot be used to predict or increase the likelihood of survival. If there were more research on seedlings from Lotus plant, there would be more sufficient evidence to hopefully correlate with my hypothesis.

There were many seedlings that were not included in the study since they did not survive the transplant. Another factor was that the lack of survivors in the parental treatment concluded the elimination of a replicate plot from each offspring treatment. The weight of the plants should have been taken at the end, concluding the total weight of leaves, flowers and pods. There was a count of the 3 leaves and the proportion of leaflets damaged (%Damage=Damage/(3\*Leaves)). The researchers could have given the weight of the *Lotus* after the damaged leaves were eaten/destroyed by *Hypera*. Weights of *Lotus* or the number of pods could have been counted more than a single day in the experiment, which could increase the weight or the chances of fecundity in the next generation.

Literature-Cited

Haan, R. L., and D. K. Barnes. 1998. Inheritance of Pod Type, Stem Color, and Dwarf Growth Habit in Medicago polymorpha. Crop Science 38:cropsci1998.0011183X003800060025x.

terHorst, C. P., and J. A. Lau. 2012. Direct and indirect transgenerational effects alter plant-herbivore interactions. Evolutionary Ecology 26:1469–1480.

Van Den Bosch, R., and V. Marble. 1971. Egyptian alfalfa weevil …the threat to California alfalfa. California Agriculture 25:3–4.